PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-189297
(43)Date of publication of application : 10.07.2001

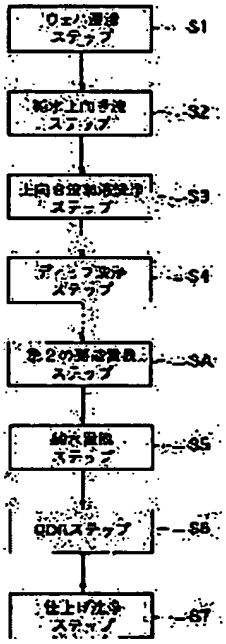
(51)Int.Cl. H01L 21/304

(21)Application number : 11-372658
(22)Date of filing : 28.12.1999

(71)Applicant : NEC CORP
(72)Inventor : SUZUKI TATSUYA

(54) METHOD AND DEVICE FOR CLEANING WAFER

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method for cleaning a wafer suited to pre-processing or post-processing for micro machining semiconductor device, using a single-tank wafer cleaning device.
SOLUTION: This cleaning method is used to clean a wafer arranged vertically in a tank, by jetting a chemical solution and a cleaning water oblequely upward or obliquely downward. This method includes a step for dipping the wafer in the tank where the cleaning water is filled and streamed, a step for cleaning the wafer by supplying a first chemical solution that an ammonium, hydrogen peroxide and water are mixed at a volume ratio of NH4OH:H2O2: water = 1:1:X1 (where X1: >20 and <70) and using an upward stream, a step for applying a dip cleaning, a step to for supplying a second chemical solution that an ammonium, hydrogen peroxide and water are mixed at a volume ratio of 1:1:X2 (X2>X1) and has a cleaning performance and to substitute the first chemical solution with the second chemical solution, a step for applying QDR cleaning, and a step to supply a rinsing water and rinse the water by using the upward stream rinsing water.



LEGAL STATUS

[Date of request for examination]	14.11.2000
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3488158
[Date of registration]	31.10.2003
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's	

decision of rejection]
[Date of extinction of right]

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CLAIMS

[Claim(s)]
[Claim 1] It has an exhaust port for QDR (Quick Down Rinse, rapid facing-down style rinse) at the pars basilaris ossis occipitalis of a cleaning tank. Or a drug solution and wash water are gushed downward [slanting] in a cleaning tank from the upper part of a cleaning tank. slanting facing up from the pars basilaris ossis occipitalis of a cleaning tank — And have the cleaning tank which was made to carry out overflow from the upper bed of a cleaning tank, and in a cleaning tank, it is isolated mutually and two or more wafers are arranged vertically. The 1st step which is the approach of washing a wafer and is immersed in a wafer into the wash water in a cleaning tank, Ammonia (NH4 OH), a hydrogen peroxide (H2 O2), and water are NH4 OH:H 2O2. : The 1st drug solution mixed by the volume ratio of water =1:1:X1 (however, X1 or more 20 70 or less range) is supplied. The 2nd step which washes a wafer with the 1st drug solution, and supply of the 1st drug solution are suspended. The 3rd step which performs DIP (Dip) washing to a wafer, and ammonia, A hydrogen peroxide and water are NH4 OH:H 2O2. : The 4th step which supplies the 2nd drug solution which is mixed by the volume ratio of water =1:1:X2 (however, X2>X1), and has washing capacity to a cleaning tank, The washing approach of the wafer characterized by having the 5th step which suspends supply of the 2nd drug solution and performs QDR washing to a wafer.
[Claim 2] X2 The washing approach of the wafer according to claim 1 characterized by being less than [more than ** 80 150].
[Claim 3] The amount of drug solutions of the 2nd drug solution supplied at the 4th step is the washing approach of the wafer according to claim 1 or 2 characterized by being the volume same at least as the volume of a cleaning tank.
[Claim 4] The washing approach of the wafer according to claim 1 or 2 characterized by having the addition step which supplies wash water to a cleaning tank, dilutes the 1st drug solution in a cleaning tank, and is made into the 2nd same ammonia concentration as a drug solution and hydrogen-peroxide concentration between the 3rd step and the 4th step.
[Claim 5] The washing approach of a wafer according to claim 4 that the sum of the amount of water of the wash water supplied at an addition step and the amount of drug solutions of the 2nd drug solution supplied at the 4th step is characterized by being the volume same at least as the volume of a cleaning tank.
[Claim 6] The washing approach of a wafer given in any 1 term of the claims 1-5 characterized by wash water being pure water.
[Claim 7] The washing approach of a wafer given in any 1 term of claims 1-6 characterized by supplying wash water after the 5th step and having the 6th step which performs finishing washing to a wafer with wash water.
[Claim 8] It has an exhaust port for QDR (Quick Down Rinse, rapid facing-down style rinse) at the pars basilaris ossis occipitalis of a cleaning tank. In the wafer washing station of the 1 tub type equipped with the cleaning tank which washes the wafer which was isolated mutually, held two or more wafers vertically, and held them The wafer washing station characterized by forming the drug solution and the wash water supply pipe which has the nozzle hole which spouts a drug solution and wash water downward [slanting] in a cleaning tank in the upper part of a cleaning

tank so that it may be located more nearly up than the wafer held in the cleaning tank.
[Claim 9] The wafer washing station according to claim 8 characterized by arranging the drug solution and the wash water supply pipe so that a nozzle hole may spout a drug solution or wash water to parallel mostly with the field of the wafer held in the cleaning tank.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the washing approach of a wafer that the elimination factor of the particle which adhered to the wafer compared with the conventional thing is high in a detail, and a wafer washing station, further about the washing approach of a wafer, and a wafer washing station.
[0002]
[Description of the Prior Art] In the manufacture process of a semiconductor device, after one process process over a wafer is completed, in order to remove the foreign matter on a wafer, an impurity, a contamination, etc., washing processing has usually been performed to the wafer. Moreover, washing processing is performed for a wafer as pretreatment of a process process in many cases. For example, they are initial washing of the beginning before processing a silicon substrate, front [oxidation] washing before forming silicon oxide on a silicon substrate, washing before ion implantation, washing before membrane formation of the CVD membrane formation film, etc.
[0003] The wafer washing station is usually used for washing processing of a wafer. Here, with reference to drawing 6 and drawing 7 , the configuration of the conventional wafer washing station currently used for washing processing of a wafer is explained. The perspective view showing the configuration of the wafer washing station of the former [drawing 6] and drawing 7 are the front views of a wafer washing station, and show the condition of having made Wafer W immersed. The wafer washing station 10 is a wafer washing station of a 1 tub type, and as shown in drawing 6 and drawing 7 , it consists of an inner lift 12 which holds penetrant removers, such as pure water and a drug solution, and washes a wafer, an outside tub 14 in which it is prepared so that the outside of an inner lift 12 may be surrounded, and a penetrant remover carries out overflow from an inner lift 12, and a pure-water supply means (not shown) and a drug solution supply means (not shown). In the wafer washing station 10, two or more wafers W are isolated mutually, are perpendicularly laid on a lifter 16, are fed in an inner lift 12, and are washed simultaneously.
[0004] A lifter 16 is a fixture which it is isolated [fixture] mutually and makes two or more wafers lay perpendicularly, for example, consists of width-of-face W1 140mm, about [depth L1 180mm] installation base 16a, and tabular handle 16b vertically prolonged up from the depth direction edge of installation base 16a. It inclines up towards both ends from a center, and only a center to height H1 30 mm is high at both ends, and installation base 16a has two or more retention-groove 16c which is isolated mutually and extended to parallel at handle 16b, inserts the pars basilaris ossis occipitalis of Wafer W in retention-groove 16c, and fixes Wafer W on installation base 16a.
[0005] An inner lift 12 is a tub of the shape of a rectangular parallelepiped of the magnitude which can hold the lifter 16 in which two or more wafers were made to lay, for example, width-of-face W2 220mm, depth L2 200mm, and about [height H2 230mm] top-face opening, and has about 10l. content volume. Moreover, the inner lift 12 equips the pars basilaris ossis occipitalis with the drain port 20 for QDR which has big opening, in order to have the drug solution and

pure-water supply pipe 18A, and B which equipped crosswise both the edges of a pars basilaris ossis occipitalis with nozzle opening which spouts a drug solution and pure water in an inner lift 12 and to carry out rapid blowdown of the drug solution or penetrant remover in an inner lift 12. The outside tub 14 was equipped with the side attachment wall which is in the method of outside only about 30mm (it displays by S at drawing 6) from the side attachment wall of the four way type of an inner lift 12, and from the upper bed of the side attachment wall of an inner lift 12, only 0 to 5mm (refer to deltah and drawing 7), an upper bed is low and is equipped with the side attachment wall of height H3 50mm. Moreover, the outside tub 14 equips the pars basilaris ossis occipitalis with the exhaust port 22 which discharges the pure water which carried out overflow from the inner lift 12, and a drug solution.

[0006] Next, with reference to drawing 8 , how to wash a wafer using the wafer washing station 10 of an above-mentioned 1 tub type is explained. Drawing 8 is a flow chart which shows the procedure of the washing approach of the conventional wafer. first, a drug solution and the pure-water supply pipe 18 -- supplying pure water to an inner lift 12 by 5l. the flow rate for /from A and B, carrying out overflow to the outside tub 14 from an inner lift 12, and maintaining the overflow condition of pure water, the lifter 16 in which the wafer was made to lay is boiled into the pure water of an inner lift 12, and it is immersed (S1 : wafer immersion step). Then, pure water is supplied to an inner lift 12 for 2 minutes by 20l. the flow rate for /from a drug solution and pure-water supply pipe 18A, and B (S2 : pure-water facing-up style step). subsequently, supply of pure water -- stopping -- ammonia (NH4 OH), a hydrogen peroxide (H2O2), and pure water -- NH4 OH:H 2O2 : the drug solution mixed by the volume ratio of pure-water =1:1:50 -- 20.8l. the flow rate for /-- a drug solution and the pure-water supply pipe 18 -- an inner lift 12 is supplied for 120 seconds from A and B, and a wafer is washed (S3 : upward style drug solution washing step). Subsequently, supply of a drug solution is suspended, the wafer laid in the lifter 16 is held for about 480 seconds, while it had been immersed in the drug solution, and the so-called DIP (Dip) washing is performed (S4 : DIP washing step).

[0007] Next, since the capacity of an inner lift 12 is about 10l., it supplies only pure water to an inner lift 12 for 30 seconds by 20l. the flow rate for /from a drug solution and pure-water supply pipe 18A, and B, and permutes the drug solution in an inner lift 12 with pure water (S5 : pure-water permutation step). Then, QDR (Quick Down Rinse, rapid downward current rinse) is performed (S6 : QDR step). In QDR washing, the drain port 20 for QDR is opened first, and it is the pure-water permutation step S5 out of an inner lift 12. The supplied pure water is discharged. Next, after stopping the drain port 20 for QDR and making an inner lift 12 full of water with pure water, the drain port 20 for QDR is opened and pure water is drained. 5 times cannot be found and this actuation is repeated 6 times. Subsequently, only pure water is supplied to an inner lift 12 for 90 seconds by 20l. the flow rate for /from a drug solution and pure-water supply pipe 18A, and B, and after the specific resistance of the pure water in an inner lift 12 checks having become the almost same value as the pure water supplied to an inner lift 12, a lifter 16 is pulled up and it transports to a desiccation tub (not shown) (S7 : finishing washing step).

[0008]

[Problem(s) to be Solved by the Invention] However, when the wafer washing station of a 1 tub type was used and a wafer was washed according to the above-mentioned washing approach, there was a problem that the elimination factor of the particle adhering to a wafer is low, and it was not so good as washing of a wafer is satisfying. That is, there was many particle which has adhered on the wafer after washing, and washing extent was inadequate as pretreatment or after treatment of the process aiming at micro processing of a semiconductor device. On the other hand, with detailed-izing of a semiconductor device, and high integration, the detailed-izing is stronger still, processing of a semiconductor device is required, and, moreover, a high precision is demanded. Therefore, by the washing approach of the conventional wafer, a wafer cannot fully be washed, so that it can respond to processing with such a high precision.

[0009] Then, the object of this invention is offering the approach of washing a wafer to extent with which can be satisfied of the demand as pretreatment or after treatment of process processes, such as micro processing of a semiconductor device, and a suitable wafer washing

station enforcing the washing approach using the wafer washing station of a 1 tub type.
[0010]
[Means for Solving the Problem] this invention person found the following thing, as a result of pursuing the cause that the cleaning effect of the conventional washing approach using the wafer washing station of a 1 tub type is low. By the conventional washing approach using the wafer washing station of a 1 tub type, since washing processing (S4 DIP washing) by the drug solution and rinse washing (S6 QDR step) by pure water are performed by the same tub, pure water has permuted the drug solution before an S6 QDR step (S5 pure-water permutation step). By the way, at the pure-water permutation step, it dissociated from the wafer in the DIP washing step, and although it is to carry out overflow of the particle of a large number which float in an inner lift 12 to the outside tub 14, and to be discharged from an inner lift 12 with the drug solution permuted with pure water, actually, it is the process of a pure-water permutation step, and has adhered to the wafer again.
[0011] That is, into the drug solution after a DIP washing step and in a cleaning tank, a drug solution is permuted by pure water and goes by the condition that much particle is floating. A drug solution is first diluted with the pure-water permutation process of a drug solution with pure water to the minimum of drug solution concentration which has the dissociating power force of particle (permutation). In the meantime, even if particle carries out the reattachment to a wafer, it is removed again, and it is discharged with a drug solution. However, if a drug solution is diluted with pure water to still lower concentration exceeding a minimum (permutation), the particle which adhered to the wafer between them will remain adhering on a wafer, without dissociating from a wafer. Consequently, a wafer [having made particle adhere freely] will be pulled up, and it will transport to a desiccation process. If it puts in another way, since pure water has permuted the drug solution simply, without preventing the reattachment of the particle at the time of the pure-water permutation of a drug solution, by the washing approach of the conventional wafer, it will be easy to carry out the reattachment of the particle as a pure-water permutation advances. Therefore, it is difficult to raise the elimination factor of particle.
[0012] Then, the thing for which the 2nd drug solution of the drug solution concentration of the minimum which has the particle dissociating power force permutes the 1st drug solution in an inner lift 12 first in case this invention person permutes the drug solution in an inner lift 12 with pure water, That is, overflow of the particle which floats in the 1st [in an inner lift 12] drug solution is carried out to the outside tub 14 from an inner lift 12 with the 1st drug solution, and it considers discharging, the 2nd drug solution permuting the 1st drug solution, and came to complete this invention for the experiment in piles.
[0013] In order to attain the above-mentioned object, the washing approach of the wafer concerning this invention It has an exhaust port for QDR (Quick Down Rinse, rapid facing-down style rinse) at the pars basilaris ossis occipitalis of a cleaning tank. Or a drug solution and wash water are gushed downward [slanting] in a cleaning tank from the upper part of a cleaning tank. slanting facing up from the pars basilaris ossis occipitalis of a cleaning tank — And have the cleaning tank which was made to carry out overflow from the upper bed of a cleaning tank, and in a cleaning tank, it is isolated mutually and two or more wafers are arranged vertically. The 1st step which is the approach of washing a wafer and is immersed in a wafer into the wash water in a cleaning tank, Ammonia (NH4 OH), a hydrogen peroxide (H2 O2), and water are NH4 OH:H 2O2. : The 1st drug solution mixed by the volume ratio of water =1:1:X1 (however, X1 or more 20 70 or less range) is supplied. The 2nd step which washes a wafer with the 1st drug solution, and supply of the 1st drug solution are suspended. The 3rd step which performs DIP (Dip) washing to a wafer, and ammonia, A hydrogen peroxide and water are NH4 OH:H 2O2. : The 4th step which supplies the 2nd drug solution which is mixed by the volume ratio of water =1:1:X2 (however, X2>X1), and has washing capacity to a cleaning tank, Supply of the 2nd drug solution is suspended and it is characterized by having the 5th step which performs QDR washing to a wafer.
[0014] The wafer washing station which enforces this invention approach may be a wafer washing station of a 1 tub type, and the conventional wafer washing station which formed the drug solution and the wash water supply pipe which has the nozzle hole which spouts a drug

solution and wash water to slanting facing up in the pars basilaris ossis occipitalis of a cleaning tank is sufficient as it. Suitably, the wafer washing station which enforces this invention approach is a wafer washing station concerning this invention mentioned later which formed the drug solution and the wash water supply pipe which has the nozzle hole which spouts a drug solution and wash water downward [slanting] in the upper part of a cleaning tank. Moreover, by this invention approach, wash water is not dissolving the chemical and means the pure water which does not contain particle. Suitably, pure water is used as wash water. On these descriptions, pure water is the so-called pure water currently used by the plant of a semiconductor device, a waterworks is processed with water treatment equipment, and the water classified as pure water is said. moreover, the particle said with this invention approach and this invention equipment -- the particle of the shape of a solid-state, such as a foreign matter, an impurity, and a contamination, -- in addition, **** of the pollutant adhering to a wafer -- it is a large concept also meaning the detailed matter.

[0015] Suitably, at the 1st step, a wafer is immersed into wash water, supplying wash water to a cleaning tank. Moreover, it is desirable after the 1st step to continue supplying wash water for a while. The time amount is the time amount which can supply the wash water of one 4 times [twice / about / to] the volume of a cleaning tank of this. The time amount which washes a wafer with the 1st drug solution at the 2nd step is the time amount which can supply the 1st drug solution of one 4 times [twice / about / to] the volume of a cleaning tank of this. The time amount which performs DIP washing at the 3rd step is the range for 10 minutes after for 5 minutes. The count which performs QDR washing at the 5th step is 7 times from 4 times. In QDR (Quick Down Rinse, rapid downward current rinse) washing, first, the drain port for QDR is opened and the 2nd drug solution is discharged from the inside of a cleaning tank. Next, after stopping the drain port for QDR and making a cleaning tank full of water with wash water, it is the actuation which opens the drain port for QDR and drains wash water. Usually, after stopping the drain port for QDR and making a cleaning tank full of water with wash water again, the drain port for QDR is opened, wash water is drained, and this actuation is repeated. QDR washing drains the wash water in a cleaning tank at once, and has the effectiveness which discharges the particle in a cleaning tank. In addition, pure water may be supplied to a cleaning tank before QDR washing of the 5th of a step, and the pure-water permutation step which permutes the 2nd drug solution with pure water may be prepared. At this time, there is no actuation which discharges the 2nd drug solution in QDR washing.

[0016] By this invention approach, before the 5th step which performs the step and QDR washing of the 3rd of DIP washing, ammonia concentration and hydrogen-peroxide concentration are lower than the 1st drug solution, the 2nd drug solution which moreover has washing capacity is supplied to a cleaning tank, and the 1st drug solution in a cleaning tank is once permuted by the 4th step. Here, washing capacity means the capacity which dissociates the particle which has adhered to the wafer in physical adsorption by Van der Waals force. Preferably, in order to raise the dilution effectiveness of the 1st drug solution by the 2nd drug solution, the 2nd ammonia concentration and hydrogen-peroxide concentration of a drug solution are made into the minimum concentration which has washing capacity. It is X2 practical. It is 150 or less [80 or more]. Conversely, if it says, it will be X2 of or more 80 150 or less range. It is the content of the water of the drug solution which can dissociate physical adsorption of particle.

[0017] While carrying out overflow of the particle which floats in the 1st [in a cleaning tank] drug solution from a cleaning tank with the 1st drug solution and discharging it, the 2nd drug solution permuting the 1st drug solution by supplying the 2nd drug solution at the 4th step by this invention approach In the 4th step, even if particle carries out the reattachment to a wafer, the adhering particle can be made to be able to dissociate according to the dissociating power force of the 2nd drug solution again, and overflow can be carried out from a cleaning tank with the 1st drug solution. Therefore, the number of particle which remains adhering to a wafer decreases substantially compared with the conventional washing approach. In addition, in order to heighten the effectiveness of this invention approach, the amount of drug solutions supplied at the 4th step is the volume same at least as the volume of a cleaning tank.

[0018] In the suitable embodiment of this invention approach, wash water is supplied to a

cleaning tank between the 3rd step and the 4th step, the 1st drug solution in a cleaning tank is diluted, and it has the addition step made into the 2nd same ammonia concentration as a drug solution and hydrogen-peroxide concentration. Moreover, the sum of the amount of water of the wash water supplied at an addition step and the amount of drug solutions of the 2nd drug solution supplied at the 5th step is the volume same at least as the volume of a cleaning tank. The requirements of the 2nd drug solution can be decreased by introducing wash water beforehand and diluting the 1st drug solution with this embodiment.

[0019] In the suitable embodiment of this invention approach, wash water is supplied after the 5th step and it has the 6th step which performs finishing washing to a wafer with wash water. Continuing is desirable until the specific resistance of the pure water in a cleaning tank checks having become the same as the specific resistance of the pure water supplied to a cleaning tank at the 6th step.

[0020] When washing a wafer according to this invention approach using the conventional wafer washing station and the 4th step or (addition step) + (4th step) is carried out, it is difficult for a drug solution or wash water to become in the style of facing up, and to dilute the 1st drug solution in a cleaning tank uniformly (permutation). Moreover, it turned out that it has the influence of a drug solution and pure-water supply pipe 18A, and B being arranged at the pars basilaris ossis occipitalis, and there is an inclination for particle to tend to adhere especially in the wafer lower part. Then, this invention person hits on an idea of forming the drug solution and pure-water supply pipe which has the nozzle hole which spouts a drug solution and wash water downward [slanting] in a cleaning tank in the upper part of a cleaning tank, and came to complete this invention for the experiment in piles.

[0021] The wafer washing station concerning this invention is QDR (Quick Down Rinse) to the pars basilaris ossis occipitalis of a cleaning tank. In the wafer washing station of the 1 tub type equipped with the cleaning tank which has an exhaust port for rapid facing-down style rinses, is isolated mutually, holds two or more wafers vertically, and washes the held wafer The drug solution and the wash water supply pipe which has the nozzle hole which spouts a drug solution and wash water downward [slanting] in a cleaning tank are characterized by being prepared in the upper part of a cleaning tank so that it may be located more nearly up than the wafer held in the cleaning tank. Moreover, the drug solution and the wash water supply pipe are arranged so that a nozzle hole may spout a drug solution or wash water to parallel mostly suitably with the field of the wafer held in the cleaning tank.

[0022]

[Embodiment of the Invention] With reference to an accompanying drawing, the example of an operation gestalt is given to below, and the gestalt of operation of this invention is explained to it at concrete and a detail.

The example of the one example operation gestalt of an operation gestalt of the washing approach of a wafer is an example of the operation gestalt of the washing approach of the wafer concerning this invention approach, and drawing 1 is a flow chart which shows the procedure of the washing approach of the wafer of this example of an operation gestalt. The washing approach of this example of an operation gestalt is S4, as it is the approach of washing a wafer using the wafer washing station 10 of the above-mentioned conventional 1 tub type and is shown in drawing 1 . A DIP washing step is performed like the conventional washing approach.

[0023] namely, — first — a drug solution and the pure-water supply pipe 18 — supplying pure water to an inner lift 12 by 5l. the flow rate for /from A and B, carrying out overflow to the outside tub 14 from an inner lift 12, and maintaining the condition, the lifter 16 in which the wafer was made to lay is boiled into the pure water of an inner lift 12, and it is immersed (S1 : wafer immersion step). Then, pure water is supplied to an inner lift 12 for 2 minutes by 20l. the flow rate for /from a drug solution and pure-water supply pipe 18A, and B (S2 : pure-water facing-up style washing step). Subsequently, supply of pure water is suspended and it is NH4 OH and H2 O2. It reaches and pure water is NH4 OH:H 2O2. : Pure water = the 1st drug solution mixed by the volume ratio of 1:1:50 is supplied to an inner lift 12 for 120 seconds by 20.8l. the flow rate for /from a drug solution and pure-water supply pipe 18A, and B, and a wafer is washed (S3 : upward style drug solution washing step). Subsequently, supply of the 1st drug solution is

suspended, the wafer laid in the lifter 16 is held for about 480 seconds, while it had been immersed in the 1st drug solution, and the so-called DIP washing is performed (S4 : DIP washing step).

[0024] Subsequently, with the approach of this example of an operation gestalt, it is the 2nd drug solution permutation step SA 1. It has. 2nd drug solution step SA 1 It is NH4 OH and H2 O2. It reaches and pure water is NH4 OH:H 2O2. : Pure water = the 2nd drug solution mixed by the volume ratio of 1:1:100 is supplied to an inner lift 12 for 30 seconds by 20.4l. the flow rate for /from a drug solution and pure-water supply pipe 18A, and B. Since the capacity of an inner lift 12 is about 10l., it means that the 1st drug solution in an inner lift 12 had been permuted by the 2nd drug solution by this.

[0025] Next, like the conventional washing approach, only pure water is supplied to an inner lift 12 for 30 seconds by 20l. the flow rate for /from a drug solution and pure-water supply pipe 18A, and B, and pure water permutes the 2nd drug solution in an inner lift 12 (S5 : pure-water permutation step). Then, it shifts to a QDR washing step. First, the drain port 20 for QDR is opened and it is the pure-water permutation step S5 out of an inner lift 12. The supplied pure water is discharged. Next, the drain port 20 for QDR is stopped, an inner lift 12 is made full of water with pure water, the drain port 20 for QDR is opened, and pure water is drained. 5 times cannot be found and this actuation is repeated 6 times (S6 : QDR step). Subsequently, only pure water is supplied to an inner lift 12 for 90 seconds by 20l. the flow rate for /from a drug solution and pure-water supply pipe 18A, and B, and after the specific resistance of the pure water in an inner lift 12 checks having become the same as the specific resistance of the pure water supplied to an inner lift 12, a lifter 16 is pulled up and it transports to a desiccation tub (not shown) (S7 : finishing washing step).

[0026] At this example of an operation gestalt, it is the 2nd drug solution permutation step SA 1. While carrying out overflow of the particle which floats in the 1st [in an inner lift 12] drug solution to the outside tub 14 from an inner lift 12 with the 1st drug solution and making it discharge, the 2nd drug solution permuting the 1st drug solution Even if particle carries out the reattachment to a wafer in the meantime, the adhering particle is again dissociated by the dissociating power force of the 2nd drug solution, and carries out overflow from a cleaning tank with the 1st drug solution. Therefore, the number of particle which remains adhering to a wafer decreases substantially compared with the conventional washing approach.

[0027] The example of the two example operation gestalt of an operation gestalt of the washing approach of a wafer is another example of the operation gestalt of the washing approach of the wafer concerning this invention approach, and drawing 2 is a flow chart which shows the procedure of the washing approach of the wafer of this example of an operation gestalt. The washing approach of this example of an operation gestalt is S4, as it is the approach of washing a wafer using the wafer washing station 10 of the above-mentioned conventional 1 tub type and is shown in drawing 2 R> 2. A DIP washing step is performed like the conventional washing approach.

[0028] Subsequently, as shown in drawing 2 by the approach of this example of an operation gestalt, it is the 1st drug solution dilution step SA 1. 2nd drug solution permutation step SA 2 It has. DIP washing step S4 Then, 1st drug solution dilution step SA 1 **** — a drug solution and the pure-water supply pipe 18 — pure water is supplied to an inner lift 12 for 15 seconds by 20l. the flow rate for /from A and B, and the 1st ammonia concentration and hydrogen-peroxide concentration of a drug solution in an inner lift 12 are diluted to the same concentration of the 2nd drug solution. Subsequently, 2nd drug solution permutation step SA 2 Supply of pure water is then suspended and it is NH4 OH and H2 O2. It reaches and pure water is NH4 OH:H 2O2. : Pure water = the 2nd drug solution mixed by the volume ratio of 1:1:100 is supplied to an inner lift 12 for 15 seconds by 20.4l. the flow rate for /from a drug solution and pure-water supply pipe 18A, and B. The 1st drug solution in an inner lift 12 is permuted with the 2nd drug solution by the dilution by pure water, and supply of the 2nd drug solution.

[0029] By it, overflow of it is carried out to the outside tub 14 from an inner lift 12 with the floating particle, the 1st drug solution being diluted with pure water by the actuation which dilutes the 1st drug solution with pure water to the concentration which loses the particle

dissociating power force, i.e., the concentration of the 2nd drug solution. Subsequently, at the 2nd drug solution permutation step, supplying the 2nd drug solution and the 2nd drug solution permuting the 1st drug solution further, overflow of the particle is carried out to the outside tub 14 from an inner lift 12 with the 1st drug solution, and it is discharged. 1st drug solution dilution step SA 1 2nd drug solution permutation step SA 2 In a process, even if particle carries out the reattachment to a wafer, since the adhering particle is again dissociated by the dissociating power force of the 2nd drug solution and carries out overflow from a cleaning tank with the 1st drug solution, the number of particle which remains adhering to a wafer decreases substantially compared with the conventional washing approach. In this example of an operation gestalt, since the 1st drug solution is diluted with pure water and the 2nd drug solution is subsequently supplied, the amount of drug solutions of the 2nd drug solution is reducible.

[0030] 2nd drug solution permutation step SA 2 They are the pure-water permutation step S5 and the QDR step S6 like [after carrying out] the conventional washing approach. And finishing washing step S7 It carries out.

[0031] The example of the example book operation gestalt of an operation gestalt of a wafer washing station is an example of the operation gestalt of the wafer washing station concerning this invention, and the perspective view in which drawing 3 shows the configuration of the wafer washing station of this example of an operation gestalt, and drawing 4 are front views, and show the condition of having made Wafer W immersed. The same sign is given to drawing 6 and the same components as drawing 7 , and a part among drawing 3 and drawing 4 , and explanation is omitted. the drug solution and the pure-water supply pipe 18 which the wafer washing station 30 of this example of an operation gestalt is a wafer washing station of a 1 tub type, and was formed in the pars basilaris ossis occipitalis of an inner lift 12 -- it replaces with A and B and is shown in drawing 3 and drawing 4 -- as -- a drug solution and the pure-water supply pipe 32 -- except for equipping the upper bed section of an inner lift 12 with A and B, it has the same configuration as the conventional washing station 10. As shown in drawing 3 and drawing 4 , a drug solution and pure-water supply pipe 32A, and B are prepared along with the upper bed section of crosswise both the edges of an inner lift 12, and are equipped with the nozzle hole 34 which spouts a drug solution or pure water toward the slanting lower part in an inner lift 12.

[0032] Thereby, it is DIP washing step S4. While the 2nd drug solution can permute uniformly the 1st drug solution in an inner lift 12, the particle adhering to the wafer lower part can be made to dissociate, in case the 2nd drug solution permutes the 1st drug solution behind.

[0033] The example of the three example operation gestalt of an operation gestalt of the washing approach of a wafer is still more nearly another example of the operation gestalt of the washing approach of the wafer concerning this invention approach, and is the washing approach using the wafer washing station 30 of the example of an operation gestalt mentioned above. Drawing 5 is a flow chart which shows the procedure of the washing approach of the wafer of this example of an operation gestalt. The washing approach of this example of an operation gestalt is S4 as shown in drawing 5 . A DIP washing step removes supplying pure water or the 1st drug solution in an inner lift 12 from a drug solution and pure-water supply pipe 32A, and B, and they are the wafer immersion step S1, the pure-water water flow step S2, and the drug solution washing step S3 like the approach of the example 2 of an operation gestalt. And DIP washing step S4 It carries out. In addition, since pure water is supplied by the downward style toward the wafer in an inner lift 12 in this example of an operation gestalt, it is the pure-water facing-up style step S2 of the example 2 of an operation gestalt. Pure-water water flow step S2 It is calling.

[0034] Subsequently, as shown in drawing 5 by the approach of this example of an operation gestalt like the example 2 of an operation gestalt, it is the 1st drug solution dilution step SA 1. 2nd drug solution permutation step SA 2 It has. a DIP washing step -- then, 1st drug solution permutation step SA 1 **** -- a drug solution and the pure-water supply pipe 32 -- pure water is supplied downward for 15 seconds by 20l. the flow rate for /from A and B at an inner lift 12, and the 1st drug solution is made to discharge, diluting the 1st ammonia concentration and hydrogen-peroxide concentration of a drug solution in an inner lift 12 to the same concentration of the 2nd drug solution Subsequently, 2nd drug solution permutation step SA 2 Then Supply of

pure water is suspended and it is NH4 OH and H2 O2. It reaches and pure water is NH4 OH:H 2O2. : The 2nd drug solution mixed by the volume ratio of 1:1:100 by 20.4l. the flow rate for /Pure water = [A drug solution and pure-water supply pipe 32A,] It supplies downward for 15 seconds from B at an inner lift 12, and actuation in which the 2nd drug solution permutes the 1st drug solution is performed.

[0035] 2nd drug solution permutation step SA 2 They are the pure-water permutation step S5 and the QDR step S6 like [after carrying out] the conventional washing approach. And finishing washing step S7 It carries out.

[0036] In addition, of course, it can perform washing a wafer as well as the approach of the example 1 of an operation gestalt using the wafer washing station 30 of the example of an operation gestalt.

[0037] In order to evaluate the effectiveness of the washing approach of the wafer of the examples 1-3 of an assessment implementation gestalt of the washing approach of the wafer of the example of an operation gestalt, the assessment trial was performed as follows. Into 0.5% of the weight of the hydrofluoric acid which dissolved in the water of the 100 weight sections and obtained the fluoric acid (HF) 1 weight section, the polystyrene latex (PLS) particle with a particle size of about 0.2 micrometers was dropped so that it might become the content of 10ppb extent by the weight ratio, and the hydrofluoric acid which made the PLS particle suspend was prepared. Subsequently, the wafer was made to pull up and season naturally to the hydrofluoric acid, for 5 minutes thru/or after being immersed for 6 minutes, and the sample wafer to which particle was made to adhere was produced. subsequently, the particle of a laser-light-scattering method -- counting -- counting of several A of the PLS particle adhering to a wafer was carried out with the machine. The number existed from 1000 to 10000 pieces. It was 99%, when the sample wafer was washed according to the approach of the example 1 of an operation gestalt, counting of several B of the PLS particle after washing was carried out and it asked for the elimination factor by the following formula.

elimination factor = (A-B) -- several [of the PLS particle before x100/AA:washing] -- the number of the PLS particles after B:washing [0038] Similarly, when asked for the elimination factor of the washing approach of the example 2 of an operation gestalt, and the example 3 of an operation gestalt, the elimination factors of the washing approach of the example 2 of an operation gestalt and the example 3 of an operation gestalt were 95% and 99% or more, respectively. On the other hand, when it asked for the elimination factor by the conventional washing approach mentioned above like the above-mentioned assessment approach for the comparison, it was 90% or less. According to the washing approach of the example 1 of an operation gestalt to the example 3 of an operation gestalt, the result of the above assessment trial shows that the elimination factor is improving remarkably compared with the conventional washing approach. Moreover, by the washing approach of the example 3 of an operation gestalt using the wafer washing station 30 of the example of an operation gestalt, although there is little amount of the 2nd drug solution used compared with the example 1 of an operation gestalt like the example 2 of an operation gestalt, an elimination factor is 99% or more like the example 1 of an operation gestalt. This shows that the cleaning effect of the wafer washing station 30 of the example of an operation gestalt is high.

[0039]

[Effect of the Invention] According to this invention approach, ammonia, a hydrogen peroxide, and water are NH4 OH:H 2O2. : The 2nd drug solution which is mixed by the volume ratio of water =1:1:X2 (however, X2 >X1), and has washing capacity is supplied. By having the 4th step which permutes the 1st drug solution with the 2nd drug solution, the step which dilutes the 1st drug solution with wash water is further prepared before the 4th step. The particle which adhered even if particle carried out the reattachment to the wafer in the 4th step, while carrying out overflow of the particle this floats in the 1st [in a cleaning tank] drug solution, permuting the 1st drug solution with the 2nd drug solution from the cleaning tank in the 1st drug solution and discharging can be made to be able to dissociate according to the dissociating power force of the 2nd drug solution again, and overflow can be carried out from a cleaning tank in the 1st drug solution. Therefore, compared with the conventional washing approach, the number of

particle which remains adhering to a wafer can decrease substantially, and can raise the elimination factor of the particle of a wafer substantially. Moreover, the wafer washing station concerning this invention has realized the washing station which can enforce this invention approach suitably.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the flow chart which shows the procedure of the washing approach of the wafer of the example 1 of an operation gestalt.
[Drawing 2] It is the flow chart which shows the procedure of the washing approach of the wafer of the example 2 of an operation gestalt.
[Drawing 3] It is the perspective view showing the configuration of the wafer washing station of the example of an operation gestalt.
[Drawing 4] It is the front view of a wafer washing station, and the condition of having made Wafer W immersed is shown.
[Drawing 5] It is the flow chart which shows the procedure of the washing approach of the wafer of the example 3 of an operation gestalt.
[Drawing 6] It is the perspective view showing the configuration of the conventional wafer washing station.
[Drawing 7] It is the front view of a wafer washing station, and the condition of having made Wafer W immersed is shown.
[Drawing 8] It is the flow chart which shows the procedure of the washing approach of the conventional wafer.
[Description of Notations]
10 Wafer Washing Station
12 Inner Lift
14 Outside Tub
16 Lifter
16a Installation base
16b Handle
16c Retention groove
18 Drug Solution and Pure-Water Supply Pipe
20 Drain Port for QDR
22 Exhaust Port
30 Wafer Washing Station of Example of Operation Gestalt
32 Drug Solution and Pure-Water Supply Pipe
34 Nozzle Hole

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2001－189297
（P2001－189297A）
(43)公開日　平成13年７月10日(2001.7.10)

(51)Int.Cl.'	識別記号	ＰＩ	テーマコード'（参考）
Ｈ０１Ｌ　21/304	６４７	Ｈ０１Ｌ　21/304	６４７Ｚ
	６４１		６４１

審査請求　有　請求項の数９　ＯＬ　（全９頁）

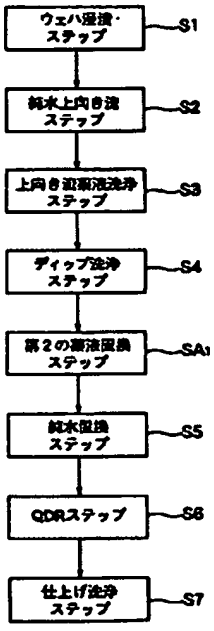
(21)出願番号　特願平11－372658

(22)出願日　平成11年12月28日(1999.12.28)

(71)出願人　000004237
日本電気株式会社
東京都港区芝五丁目７番１号
(72)発明者　鈴木　達也
東京都港区芝五丁目７番１号　日本電気株式会社内
(74)代理人　100096231
弁理士　稲垣　清

(54)【発明の名称】　ウエハの洗浄方法及びウエハ洗浄装置

(57)【要約】
【課題】　一槽式のウエハ洗浄装置を使って、半導体装置の微細加工を目的とするプロセスの前処理又は後処理に対応したウエハの洗浄方法を提供する。
【解決手段】　本洗浄方法は、洗浄槽内で斜め上向きに、又は斜め下向きに薬液及び洗浄水を噴出させ、槽内に垂直に配置したウエハを洗浄する方法である。本方法は、洗浄水が溢流する槽内にウエハを浸漬するステップと、アンモニア、過酸化水素、及び水が、ＮＨ，ＯＨ：Ｈ，Ｏ，：水＝１：１：Ｘ，（但し、Ｘ，が２０以上７０以下の範囲）の体積比で混合された第１の薬液を供給して、上向き流薬液で洗浄するステップと、ディップ洗浄を施すステップと、アンモニア、過酸化水素、及び水が１：１：Ｘ，（但し、Ｘ，＞Ｘ，）の体積比で混合され、かつ洗浄能力を有する第２の薬液を供給して、第１の薬液を第２の薬液で置換するステップと、ＱＤＲ洗浄を施すステップと、洗浄水を供給して、上向き流洗浄水で仕上げ洗浄を施すステップとを有する。



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【特許請求の範囲】

【請求項１】　洗浄槽の底部にＱＤＲ（Quick Down Rinse、急速下向き流リンス）用排出口を有し、洗浄槽の底部から斜め上向きに、又は洗浄槽の上部から斜め下向きに薬液及び洗浄水を洗浄槽内に噴出させ、かつ洗浄槽の上端から溢流させるようにした洗浄槽を備え、洗浄槽内に複数枚のウエハを相互に隔隔して垂直に配置して、ウエハを洗浄する方法であって、

洗浄槽内の洗浄水中にウエハを浸漬する第１のステップと、

アンモニア（ＮＨ，ＯＨ）、過酸化水素（Ｈ，Ｏ，）、及び水が、ＮＨ，ＯＨ：Ｈ，Ｏ，：水＝１：１：Ｘ，（但し、Ｘ，が２０以上７０以下の範囲）の体積比で混合された第１の薬液を供給して、第１の薬液でウエハを洗浄する第２のステップと、

第１の薬液の供給を停止して、ウエハにディップ（Ｄｉｐ）洗浄を施す第３のステップと、

アンモニア、過酸化水素、及び水が、ＮＨ，ＯＨ：Ｈ，Ｏ，：水＝１：１：Ｘ，（但し、Ｘ，＞Ｘ，）の体積比で混合され、かつ洗浄能力を有する第２の薬液を洗浄槽に供給する第４のステップと、

第２の薬液の供給を停止し、ＱＤＲ洗浄をウエハに施す第５のステップとを有することを特徴とするウエハの洗浄方法。

【請求項２】　Ｘ，が８０以上１５０以下であることを特徴とする請求項１に記載のウエハの洗浄方法。

【請求項３】　第４のステップで供給する第２の薬液の薬液量は、少なくとも洗浄槽の容積と同じ体積であることを特徴とする請求項１又は２に記載のウエハの洗浄方法。

【請求項４】　第３のステップと第４のステップとの間に、洗浄槽に洗浄水を供給して洗浄槽内の第１の薬液を希釈し、第２の薬液と同じアンモニア濃度及び過酸化水素濃度にする付加ステップを有することを特徴とする請求項１又は２に記載のウエハの洗浄方法。

【請求項５】　付加ステップで供給する洗浄水の水量と第４のステップで供給する第２の薬液の薬液量との和が、少なくとも洗浄槽の容積と同じ体積であることを特徴とする請求項４に記載のウエハの洗浄方法。

【請求項６】　洗浄水が純水であることを特徴とする請求項１から５のうちのいずれか１項に記載のウエハの洗浄方法。

【請求項７】　第５のステップの後に、洗浄水を供給して、洗浄水で仕上げ洗浄をウエハに施す第６のステップを有することを特徴とする請求項１から６のいずれか１項に記載のウエハの洗浄方法。

【請求項８】　洗浄槽の底部にＱＤＲ（Quick Down Rinse、急速下向き流リンス）用排出口を有し、複数枚のウエハを相互に隔隔して垂直に収容し、収容したウエハを洗浄する洗浄槽を備えた一槽式のウエハ洗浄装置において、

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洗浄槽内に斜め下向きに薬液及び洗浄水を噴出するノズル孔を有する薬液・洗浄水供給管が、洗浄槽内に収容されたウエハより上方に位置するように洗浄槽の上部に設けられていることを特徴とするウエハ洗浄装置。

【請求項９】　ノズル孔が、洗浄槽内に収容されたウエハの面とほぼ平行に薬液又は洗浄水を噴出するように、薬液・洗浄水供給管が配置されていることを特徴とする請求項８に記載のウエハ洗浄装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、ウエハの洗浄方法及びウエハ洗浄装置に関し、更に詳細には、従来のものに比べてウエハに付着したパーティクルの除去率が高い、ウエハの洗浄方法及びウエハ洗浄装置に関するものである。

【０００２】

【従来の技術】半導体装置の製造過程では、ウエハに対する一つのプロセス工程が終了すると、通常、ウエハ上の異物、不純物、汚染物等を除去するために、ウエハに洗浄処理を施している。また、プロセス工程の前処理として洗浄処理をウエハを施すことも多い。例えば、シリコン基板を加工する前の最初の初期洗浄、シリコン基板上にシリコン酸化膜を成膜する前の酸化前洗浄、イオン打ち込み前の洗浄、ＣＶＤ成膜膜の成膜前の洗浄等である。

【０００３】ウエハの洗浄処理には、通常、ウエハ洗浄装置が使用されている。ここで、図６及び図７を参照して、ウエハの洗浄処理に使用している従来のウエハ洗浄装置の構成を説明する。図６は従来のウエハ洗浄装置の構成を示す斜視図、及び図７はウエハ洗浄装置の正面図であって、ウエハＷを浸漬させた状態を示す。ウエハ洗浄装置１０は、一槽式のウエハ洗浄装置であって、図６及び図７に示すように、純水、薬液等の洗浄液を収容してウエハを洗浄する内槽１２と、内槽１２の外側を取り巻くように設けられ、内槽１２から洗浄液が溢流する外槽１４と、純水供給手段（図示せず）及び薬液供給手段（図示せず）とから構成されている。ウエハ洗浄装置１０では、複数枚のウエハＷが、相互に隔隔して垂直方向にリフタ１６上に載置され、内槽１２内に送入されて、同時に洗浄される。

【０００４】リフタ１６は、複数枚のウエハを相互に隔隔して垂直方向に載置させる治具であって、例えば幅Ｗ，１４０ｍｍ、奥行きＬ，１８０ｍｍ程度の載置台１６ａと、載置台１６ａの奥行き方向縁部から垂直に上方に延びる板状の把手１６ｂとから構成される。載置台１６ａは、中央から両端部に向けて上方に傾斜し、両端部で中央から高さＨ，３０ｍｍだけ高くなっていて、かつ、相互に隔隔して把手１６ｂに平行に伸びる複数個の保持溝１６ｃを有し、保持溝１６ｃにウエハＷの底部を挿入

して、ウエハWを載置台１６ａ上に固定するようになっている。

【０００５】内槽１２は、複数枚のウエハを載置させたリフタ１６を収容できる大きさ、例えば幅W，２２０ｍｍ、奥行きL，２００ｍｍ、高さH，２３０ｍｍ程度の上面開口の直方体状の槽であって、約１０リットルの内容積を有する。また、内槽１２は、底部の幅方向両縁部に薬液及び純水を内槽１２内に噴出するノズル口を備えた薬液・純水供給管１８Ａ、Ｂを備え、かつ内槽１２内の薬液又は洗浄液を急速排出するために大きな開口を有するＱＤＲ用ドレイン口２０を底部に備えている。外槽１４は、内槽１２の四方の側壁より約３０ｍｍ（図６ではＳで表示）だけ外方にある側壁を備え、かつ上端が内槽１２の側壁の上端より０ｍｍから５ｍｍ（Δｈ、図７参照）だけ低く、高さH，５０ｍｍの側壁を備えている。また、外槽１４は、内槽１２から溢流した純水や薬液を排出する排出口２２を底部に備えている。

【０００６】次に、図８を参照して、上述の一槽式のウエハ洗浄装置１０を使ってウエハを洗浄する方法を説明する。図８は従来のウエハの洗浄方法の手順を示すフローチャートである。先ず、薬液・純水供給管１８Ａ、Ｂから純水を内槽１２に５リットル／分の流量で供給し、内槽１２から外槽１４に溢流させ、純水の溢流状態を維持しつつ、ウエハを載置させたリフタ１６を内槽１２の純水中に浸漬する（S_1：ウエハ浸漬ステップ）。続いて、薬液・純水供給管１８Ａ、Ｂから純水を内槽１２に２０リットル／分の流量で２分間供給する（S_2：純水上向き流ステップ）。次いで、純水の供給を停止し、アンモニア（ＮＨ，ＯＨ）、過酸化水素（H_2O_2）及び純水がＮＨ，ＯＨ：H_2O_2：純水＝１：１：５０の体積比で混合された薬液を２０．８リットル／分の流量で薬液・純水供給管１８Ａ、Ｂから内槽１２に１２０秒間供給して、ウエハを洗浄する（S_3：上向き流薬液洗浄ステップ）。次いで、薬液の供給を停止し、リフタ１６に載置されたウエハを薬液に浸漬したまま、約４８０秒間保持していわゆるディップ（Ｄｉｐ）洗浄を行う（S_4：ディップ洗浄ステップ）。

【０００７】次に、内槽１２の容量は、約１０リットルなので、２０リットル／分の流量で純水のみを薬液・純水供給管１８Ａ、Ｂから内槽１２に３０秒間供給して、内槽１２内の薬液を純水で置換する（S_5：純水置換ステップ）。続いて、ＱＤＲ（Quick Down Rinse、急速下降流リンス）を行う（S_6：ＱＤＲステップ）。ＱＤＲ洗浄では、先ず、ＱＤＲ用ドレイン口２０を開放して、内槽１２内から純水置換ステップS_5で供給した純水を排出する。次に、ＱＤＲ用ドレイン口２０を閉止して、内槽１２を純水で満水にした後、またＱＤＲ用ドレイン口２０を開放して純水を排水する。この操作を５回ないし６回繰り返す。次いで、２０リットル／分の流量で純水のみを薬液・純水供給管１８Ａ、Ｂから内槽１２に９０秒間供給して、内槽１２内の純水の比抵抗が、内槽１２に供給する純水とほぼ同じ値になったことを確認した後、リフタ１６を引き上げ、乾燥槽（図示せず）に移送する（S_7：仕上げ洗浄ステップ）。

【０００８】

【発明が解決しようとする課題】しかし、一槽式のウエハ洗浄装置を使い、上述の洗浄方法に従ってウエハを洗浄した場合、ウエハに付着したパーティクルの除去率が低く、ウエハの洗浄が満足できるほど良好でないという問題があった。つまり、洗浄後のウエハ上に付着しているパーティクルの数が多く、半導体装置の微細加工を目的とするプロセスの前処理又は後処理としては、洗浄程度が不十分であった。一方、半導体装置の微細化、高集積化に伴い、半導体装置のプロセッシングは、その微細化が益々強く要求され、しかも高い精度が要求されている。従って、従来のウエハの洗浄方法では、このような精度の高いプロセッシングに対応できる程ウエハを十分に洗浄することができない。

【０００９】そこで、本発明の目的は、一槽式のウエハ洗浄装置を使って、半導体装置の微細加工等のプロセス工程の前処理又は後処理としての要求を満足できる程度にウエハを洗浄する方法、及びその洗浄方法を実施するのに好適なウエハ洗浄装置を提供することである。

【００１０】

【課題を解決するための手段】本発明者は、一槽式のウエハ洗浄装置を使った従来の洗浄方法の洗浄効果が低い原因を追求した結果、次のことが判った。一槽式のウエハ洗浄装置を使った従来の洗浄方法では、薬液による洗浄処理（Ｓ，ディップ洗浄）と、純水によるリンス洗浄（Ｓ，ＱＤＲステップ）とを同じ槽で行っているので、Ｓ，ＱＤＲステップの前に、純水で薬液を置換している（Ｓ，純水置換ステップ）。ところで、純水置換ステップでは、ディップ洗浄ステップ中にウエハから解離して、内槽１２内に浮遊する多数のパーティクルは、純水で置換される薬液と共に内槽１２から外槽１４に溢流して排出されることになっているものの、現実には、純水置換ステップの過程で、再びウエハに付着している。

【００１１】つまり、ディップ洗浄ステップの後、洗浄槽内の薬液中にパーティクルが多数浮遊している状態で、薬液が純水によって置換されて行く。薬液の純水置換過程では、先ず、薬液はパーティクルの解離能力を有する薬液濃度の下限まで純水で希釈（置換）される。その間は、パーティクルがウエハに再付着しても再び除去され、薬液と共に排出される。しかし、下限を超えて更に低い濃度まで、薬液が純水で希釈（置換）されると、その間にウエハに付着したパーティクルはウエハから解離することなく、ウエハ上に付着したままになる。その結果、パーティクルを付着させたままのウエハを引き上げて、乾燥工程に移送することになる。換言すれば、従来のウエハの洗浄方法では、薬液の純水置換時のパーテ

ィクルの再付着を防止することなく、単純に薬液を純水で置換しているために、純水置換が進行するにつれてパーティクルが再付着し易くなっている。従って、パーティクルの除去率を高めることが難しい。

【００１２】そこで、本発明者は、内槽１２内の薬液を純水で置換する際、先ず、パーティクル解離能力を有する下限の薬液濃度の第２の薬液で内槽１２内の第１の薬液を置換すること、即ち第１の薬液を第２の薬液で置換しつつ内槽１２内の第１の薬液中に浮遊するパーティクルを第１の薬液と共に内槽１２から外槽１４に溢流させて、排出することを考え、実験を重ねて、本発明を完成するに到った。

【００１３】上記目的を達成するために、本発明に係るウエハの洗浄方法は、洗浄槽の底部にＱＤＲ（Quick Down Rinse、急速下向き流リンス）用排出口を有し、洗浄槽の底部から斜め上向きに、又は洗浄槽の上部から斜め下向きに薬液及び洗浄水を洗浄槽内に噴出させ、かつ洗浄槽の上端から溢流させるようにした洗浄槽を備え、洗浄槽内に複数枚のウエハを相互に離隔して垂直に配置して、ウエハを洗浄する方法であって、洗浄槽内の洗浄水中にウエハを浸漬する第１のステップと、アンモニア（NH_4OH）、過酸化水素（H_2O_2）、及び水が、$NH_4OH:H_2O_2:水=1:1:X_1$（但し、X_1が２０以上７０以下の範囲）の体積比で混合された第１の薬液を供給して、第１の薬液でウエハを洗浄する第２のステップと、第１の薬液の供給を停止して、ウエハにディップ（Ｄｉｐ）洗浄を施す第３のステップと、アンモニア、過酸化水素、及び水が、$NH_4OH:H_2O_2:水=1:1:X_2$（但し、$X_2>X_1$）の体積比で混合され、かつ洗浄能力を有する第２の薬液を洗浄槽に供給する第４のステップと、第２の薬液の供給を停止し、ＱＤＲ洗浄をウエハに施す第５のステップとを有することを特徴としている。

【００１４】本発明方法を実施するウエハ洗浄装置は、一槽式のウエハ洗浄装置であって、斜め上向きに薬液及び洗浄水を噴出するノズル孔を有する薬液・洗浄水供給管を洗浄槽の底部に設けた、従来のウエハ洗浄装置でも良い。好適には、本発明方法を実施するウエハ洗浄装置は、斜め下向きに薬液及び洗浄水を噴出するノズル孔を有する薬液・洗浄水供給管を洗浄槽の上部に設けた、後述する本発明に係るウエハ洗浄装置である。また、本発明方法で、洗浄水とは、化学物質を溶解していない、かつパーティクルを含まない清浄な水を言う。好適には、洗浄水として純水を使用する。本明細書で、純水とは、半導体装置の製造工場で使われている、所謂、純水であって、上水を水処理装置で処理し、純水として分類されている水を言う。また、本発明方法及び本発明装置で言うパーティクルとは、異物、不純物、汚染物等の固体状の微粒子に加えて、ウエハに付着した汚染物質の極く微細な物質をも意味する広い概念である。

【００１５】好適には、第１のステップでは、洗浄槽に洗浄水を供給しつつ、ウエハを洗浄水中に浸漬する。また、第１のステップの後、暫く、洗浄水を供給し続けることが望ましい。その時間は、洗浄槽の約２倍から４倍の体積の洗浄水を供給できる時間である。第２のステップで、第１の薬液でウエハを洗浄する時間は、洗浄槽の約２倍から４倍の体積の第１の薬液を供給できる時間である。第３のステップで、ディップ洗浄を行う時間は、５分間から１０分間の範囲である。第５のステップで、ＱＤＲ洗浄を行う回数は、４回から７回である。ＱＤＲ（Quick Down Rinse、急速下降流リンス）洗浄では、先ず、ＱＤＲ用ドレイン口を開放して、洗浄槽内から第２の薬液を排出する。次に、ＱＤＲ用ドレイン口を閉止して、洗浄槽を洗浄水で満水にした後、またＱＤＲ用ドレイン口を開放して洗浄水を排水する操作である。通常は、再び、ＱＤＲ用ドレイン口を閉止して、洗浄槽を洗浄水で満水にした後、またＱＤＲ用ドレイン口を開放して洗浄水を排水し、この操作を繰り返す。ＱＤＲ洗浄は、一挙に洗浄槽内の洗浄水を排水して、洗浄槽内のパーティクルを排出する効果を有する。尚、第５のステップのＱＤＲ洗浄の前に洗浄槽に純水を供給して、第２の薬液を純水で置換する純水置換ステップを設けても良い。このときには、ＱＤＲ洗浄に当たって、第２の薬液を排出する操作はない。

【００１６】本発明方法では、ディップ洗浄の第３のステップと、ＱＤＲ洗浄を施す第５のステップの前に、一旦、第４のステップで、アンモニア濃度及び過酸化水素濃度が第１の薬液より低く、しかも洗浄能力を有する第２の薬液を洗浄槽に供給して、洗浄槽内の第１の薬液を置換する。ここで、洗浄能力とは、ファンデルワールス力による物理吸着でウエハに付着しているパーティクルを解離する能力を言う。好ましくは、第２の薬液による第１の薬液の希釈効率を高めるために、第２の薬液のアンモニア濃度及び過酸化水素濃度は、洗浄能力を有する下限濃度にする。実用的には、X_2が８０以上１５０以下である。逆に言えば、８０以上１５０以下の範囲のX_2が、パーティクルの物理吸着を解離できる薬液の水の含有量である。

【００１７】本発明方法では、第４のステップで第２の薬液を供給することにより、第１の薬液を第２の薬液で置換しつつ洗浄槽内の第１の薬液中に浮遊するパーティクルを第１の薬液と共に洗浄槽から溢流させて、排出すると共に、第４のステップ中で、パーティクルがウエハに再付着しても、付着したパーティクルを再び第２の薬液の解離能力によって解離させ、第１の薬液と共に洗浄槽から溢流させることができる。よって、ウエハに付着したままになるパーティクルの数が、従来の洗浄方法に比べて、大幅に減少する。尚、本発明方法の効果を高めるには、第４のステップで供給する薬液量は、少なくとも洗浄槽の容積と同じ体積である。

【００１８】本発明方法の好適な実施態様では、第３のステップと第４のステップとの間に、洗浄槽に洗浄水を供給して洗浄槽内の第１の薬液を希釈し、第２の薬液と同じアンモニア濃度及び過酸化水素濃度にする付加ステップを有する。また、付加ステップで供給する洗浄水の水量と第５のステップで供給する第２の薬液の薬液量との和が、少なくとも洗浄槽の容積と同じ体積である。本実施態様では、洗浄水を予め導入して第１の薬液を希釈することにより、第２の薬液の所要量を減少させることができる。

【００１９】本発明方法の好適な実施態様では、第５のステップの後に、洗浄水を供給して、洗浄水で仕上げ洗浄をウエハに施す第６のステップを有する。第６のステップでは、洗浄槽内の純水の比抵抗が、洗浄槽に供給する純水の比抵抗と同じになったことを確認するまで、続行することが望ましい。

【００２０】従来のウエハ洗浄装置を使って本発明方法に従ってウエハを洗浄する場合、第４のステップ、又は（付加ステップ）＋（第４のステップ）を実施すると、薬液、又は洗浄水が上向き流になって、洗浄槽内の第１の薬液を一様に希釈（置換）することが難しい。また、薬液・純水供給管１８Ａ、Ｂが底部に配置されている等の影響もあって、特にウエハ下部には、パーティクルが付着し易い傾向があることが判った。そこで、本発明者は、洗浄槽内に斜め下向きに薬液及び洗浄水を噴出するノズル孔を有する薬液・純水供給管を洗浄槽の上部に設けることを着想し、実験を重ねて、本発明を完成するに到った。

【００２１】本発明に係るウエハ洗浄装置は、洗浄槽の底部にＱＤＲ（Quick Down Rinse、急速下向き流リンス）用排出口を有し、複数枚のウエハを相互に離隔して垂直に収容し、収容したウエハを洗浄する洗浄槽を備えた一槽式のウエハ洗浄装置において、洗浄槽内に斜め下向きに薬液及び洗浄水を噴出するノズル孔を有する薬液・洗浄水供給管が、洗浄槽内に収容されたウエハより上方に位置するように洗浄槽の上部に設けられていることを特徴としている。また、好適には、ノズル孔が、洗浄槽内に収容されたウエハの面とほぼ平行に薬液又は洗浄水を噴出するように、薬液・洗浄水供給管が配置されている。

【００２２】

【発明の実施の形態】以下に、添付図面を参照し、実施形態例を挙げて本発明の実施の形態を具体的かつ詳細に説明する。

ウエハの洗浄方法の実施形態例１

本実施形態例は、本発明方法に係るウエハの洗浄方法の実施形態の一例であって、図１は本実施形態例のウエハの洗浄方法の手順を示すフローチャートである。本実施形態例の洗浄方法は、前述の従来の一槽式のウエハ洗浄装置１０を使ってウエハを洗浄する方法であって、図１に示すように、Ｓ，ディップ洗浄ステップまでは、従来の洗浄方法と同じように行う。

【００２３】即ち、先ず、薬液・純水供給管１８Ａ、Ｂから純水を内槽１２に５リットル／分の流量で供給し、内槽１２から外槽１４に溢流させ、その状態を維持しつつ、ウエハを載置させたリフタ１６を内槽１２の純水中にに浸漬する（Ｓ，：ウエハ浸漬ステップ）。続いて、薬液・純水供給管１８Ａ、Ｂから純水を内槽１２に２０リットル／分の流量で２分間供給する（Ｓ，：純水上向き流洗浄ステップ）。次いで、純水の供給を停止し、ＮＨ，ＯＨ、Ｈ，Ｏ，及び純水がＮＨ，ＯＨ：Ｈ，Ｏ，：純水＝１：１：５０の体積比で混合された第１の薬液を２０．８リットル／分の流量で薬液・純水供給管１８Ａ、Ｂから内槽１２に１２０秒間供給して、ウエハを洗浄する（Ｓ，：上向き流薬液洗浄ステップ）。次いで、第１の薬液の供給を停止し、リフタ１６に載置されたウエハを第１の薬液に浸漬したまま、約４８０秒間保持して、いわゆるディップ洗浄を行う（Ｓ，：ディップ洗浄ステップ）。

【００２４】次いで、本実施形態例の方法では、第２の薬液置換ステップＳＡ，を備えている。第２の薬液ステップＳＡ，では、ＮＨ，ＯＨ、Ｈ，Ｏ，及び純水がＮＨ，ＯＨ：Ｈ，Ｏ，：純水＝１：１：１００の体積比で混合された第２の薬液を２０．４リットル／分の流量で薬液・純水供給管１８Ａ、Ｂから内槽１２に３０秒間供給する。これにより、内槽１２の容量は、約１０リットルなので、内槽１２内の第１の薬液が第２の薬液で置換されたことになる。

【００２５】次に、従来の洗浄方法と同様にして、２０リットル／分の流量で純水のみを薬液・純水供給管１８Ａ、Ｂから内槽１２に３０秒間供給して、内槽１２内の第２の薬液を純水で置換する（Ｓ，：純水置換ステップ）。続いて、ＱＤＲ洗浄ステップに移行する。先ず、ＱＤＲ用ドレイン口２０を開放して、内槽１２内から純水置換ステップＳ，で供給した純水を排出する。次に、ＱＤＲ用ドレイン口２０を閉止して、内槽１２を純水で満水にし、ＱＤＲ用ドレイン口２０を開放して純水を排水する。この操作を５回ないし６回繰り返して、（Ｓ，：ＱＤＲステップ）。次いで、２０リットル／分の流量で純水のみを薬液・純水供給管１８Ａ、Ｂから内槽１２に９０秒間供給して、内槽１２内の純水の比抵抗が、内槽１２に供給する純水の比抵抗と同じになったことを確認した後、リフタ１６を引き上げ、乾燥槽（図示せず）に移送する（Ｓ，：仕上げ洗浄ステップ）。

【００２６】本実施形態例では、第２の薬液置換ステップＳＡ，で、第１の薬液を第２の薬液で置換しつつ内槽１２内の第１の薬液中に浮遊するパーティクルを第１の薬液と共に内槽１２から外槽１４に溢流させて、排出させると共に、この間、パーティクルがウエハに再付着しても、付着したパーティクルは、再び第２の薬液の解離

能力によって解離され、第１の薬液と共に洗浄槽から溢流する。従って、ウエハに付着したままになるパーティクルの数が、従来の洗浄方法に比べて、大幅に減少する。

【００２７】ウエハの洗浄方法の実施形態例２

本実施形態例は、本発明方法に係るウエハの洗浄方法の実施形態の別の例であって、図２は本実施形態例のウエハの洗浄方法の手順を示すフローチャートである。本実施形態例の洗浄方法は、前述の従来の一槽式のウエハ洗浄装置１０を使ってウエハを洗浄する方法であって、図２に示すように、Ｓ，ディップ洗浄ステップまでは、従来の洗浄方法と同じように行う。

【００２８】次いで、本実施形態例の方法では、図２に示すように、第１の薬液希釈ステップＳＡ，と第２の薬液置換ステップＳＡ，とを備えている。ディップ洗浄ステップＳ，に続いて、第１の薬液希釈ステップＳＡ，では、薬液・純水供給管１８Ａ、Ｂから純水を内槽１２に２０リットル／分の流量で１５秒間供給し、内槽１２内の第１の薬液のアンモニア濃度及び過酸化水素濃度を第２の薬液の同じ濃度に希釈する。次いで、第２の薬液置換ステップＳＡ，では、純水の供給を停止し、ＮＨ，ＯＨ、Ｈ，Ｏ，及び純水がＮＨ，ＯＨ：Ｈ，Ｏ，：純水＝１：１：１００の体積比で混合された第２の薬液を２０．４リットル／分の流量で薬液・純水供給管１８Ａ、Ｂから内槽１２に１５秒間供給する。純水による希釈及び第２の薬液の供給によって、内槽１２内の第１の薬液は、第２の薬液で置換される。

【００２９】第１の薬液を純水で希釈する操作により、第１の薬液は、パーティクル解離能力を喪失する濃度、即ち第２の薬液の濃度まで純水で希釈されつつ、浮遊するパーティクルと共に内槽１２から外槽１４に溢流する。次いで、第２の薬液置換ステップでは、第２の薬液を供給して、更に第１の薬液を第２の薬液で置換しつつパーティクルを第１の薬液と共に内槽１２から外槽１４に溢流させ、排出する。第１の薬液希釈ステップＳＡ，と第２の薬液置換ステップＳＡ，の過程で、パーティクルがウエハに再付着しても、付着したパーティクルは、再び第２の薬液の解離能力によって解離され、第１の薬液と共に洗浄槽から溢流するので、ウエハに付着したままになるパーティクルの数が、従来の洗浄方法に比べて、大幅に減少する。本実施形態例では、第１の薬液を純水で希釈し、次いで第２の薬液を供給しているので、第２の薬液の薬液量を節減することができる。

【００３０】第２の薬液置換ステップＳＡ，を実施した後、従来の洗浄方法と同様にして、純水置換ステップＳ，、ＱＤＲステップＳ，及び仕上げ洗浄ステップＳ，を実施する。

【００３１】ウエハ洗浄装置の実施形態例

本実施形態例は、本発明に係るウエハ洗浄装置の実施形態の一例であって、図３は本実施形態例のウエハ洗浄装置の構成を示す斜視図、及び図４は正面図であって、ウエハＷを浸漬させた状態を示す。図３及び図４中、図６及び図７と同じ部品、部位には同じ符号を付して、説明を省略する。本実施形態例のウエハ洗浄装置３０は、一槽式のウエハ洗浄装置であって、内槽１２の底部に設けられた薬液・純水供給管１８Ａ、Ｂに代えて、図３及び図４に示すように、薬液・純水供給管３２Ａ、Ｂを内槽１２の上端部に備えていることを除いて従来の洗浄装置１０と同じ構成を備えている。薬液・純水供給管３２Ａ、Ｂは、図３及び図４に示すように、内槽１２の幅方向両縁部の上端部に沿って設けてあり、内槽１２内斜め下方に向かって薬液又は純水を噴出するノズル孔３４を備えている。

【００３２】これにより、ディップ洗浄ステップＳ，後に第１の薬液を第２の薬液で置換する際、内槽１２内の第１の薬液を一様に第２の薬液で置換することができると共にウエハ下部に付着したパーティクルを解離させることができる。

【００３３】ウエハの洗浄方法の実施形態例３

本実施形態例は、本発明方法に係るウエハの洗浄方法の実施形態の更に別の例であって、上述した実施形態例のウエハ洗浄装置３０を使った洗浄方法である。図５は本実施形態例のウエハの洗浄方法の手順を示すフローチャートである。本実施形態例の洗浄方法は、図５に示すように、Ｓ，ディップ洗浄ステップまでは、薬液・純水供給管３２Ａ、Ｂから純水又は第１の薬液を内槽１２内に供給することを除いて実施形態例２の方法と同様に、ウエハ浸漬ステップＳ，、純水通水ステップＳ，、薬液洗浄ステップＳ，及びディップ洗浄ステップＳ，を行う。尚、本実施形態例では、内槽１２内のウエハに向かって下向き流で純水を供給しているので、実施形態例２の純水上向き流ステップＳ，を純水通水ステップＳ，と呼んでいる。

【００３４】次いで、実施形態例２と同様に、本実施形態例の方法では、図５に示すように、第１の薬液希釈ステップＳＡ，と第２の薬液置換ステップＳＡ，とを備えている。ディップ洗浄ステップに続いて、第１の薬液置換ステップＳＡ，では、薬液・純水供給管３２Ａ、Ｂから下向きに純水を内槽１２に２０リットル／分の流量で１５秒間供給し、内槽１２内の第１の薬液のアンモニア濃度及び過酸化水素濃度を第２の薬液の同じ濃度に希釈しつつ第１の薬液を排出させる。次いで、第２の薬液置換ステップＳＡ，では、純水の供給を停止し、ＮＨ，ＯＨ、Ｈ，Ｏ，及び純水がＮＨ，ＯＨ：Ｈ，Ｏ，：純水＝１：１：１００の体積比で混合された第２の薬液を２０．４リットル／分の流量で薬液・純水供給管３２Ａ、Ｂから下向きに内槽１２に１５秒間供給して、第１の薬液を第２の薬液で置換する操作を行う。

【００３５】第２の薬液置換ステップＳＡ，を実施した後、従来の洗浄方法と同様にして、純水置換ステップＳ

，、ＱＤＲステップＳ。及び仕上げ洗浄ステップＳ，を実施する。

【００３６】尚、実施形態例のウエハ洗浄装置３０を使って、実施形態例１の方法と同様にして、ウエハを洗浄することも、勿論できる。

【００３７】実施形態例のウエハの洗浄方法の評価

実施形態例１から３のウエハの洗浄方法の効果を評価するために、以下のようにして評価試験を行った。フッ酸（ＨＦ）１重量部を１００重量部の水に溶解して得た０．５重量％のフッ化水素酸中に粒径約０．２μｍのポリスチレン・ラテックス（ＰＬＳ）粒子を重量比で１０ｐｐｂ程度の含有率になるように滴下して、ＰＬＳ粒子を懸濁させたフッ化水素酸を調製した。次いで、そのフッ化水素酸にウエハを５分間ないし６分間浸漬した後、引き上げて自然乾燥させ、パーティクルを付着させた試料ウエハを作製した。次いで、レーザ光散乱方式のパーティクル計数機によって、ウエハに付着したＰＬＳ粒子の数Ａを計数した。その数は、１０００個から１０００個の間にあった。実施形態例１の方法に従って試料ウエハを洗浄し、洗浄後のＰＬＳ粒子の数Ｂを計数して、次の式で除去率を求めたところ、９９％であった。

除去率＝（Ａ－Ｂ）×１００／Ａ

Ａ：洗浄前のＰＬＳ粒子の数

Ｂ：洗浄後のＰＬＳ粒子の数

【００３８】同様にして、実施形態例２及び実施形態例３の洗浄方法の除去率を求めたところ、実施形態例２及び実施形態例３の洗浄方法の除去率は、それぞれ、９５％及び９９％以上であった。一方、比較のために、前述した従来の洗浄方法による除去率を上述の評価方法と同様にして求めたところ、９０％以下であった。以上の評価試験の結果から、実施形態例１から実施形態例３の洗浄方法によれば、従来の洗浄方法に比べて、除去率が著しく向上していることが判る。また、実施形態例のウエハ洗浄装置３０を使った実施形態例３の洗浄方法では、実施形態例２と同様に第２の薬液の使用量が実施形態例１に比べて少ないものの、除去率は実施形態例１と同様に９９％以上である。これは、実施形態例のウエハ洗浄装置３０の洗浄効果が高いことを示している。

【００３９】

【発明の効果】本発明方法によれば、アンモニア、過酸化水素、及び水が、ＮＨ$_4$ＯＨ：Ｈ$_2$Ｏ$_2$：水＝１：１：Ｘ$_1$（但し、Ｘ$_2$＞Ｘ$_1$）の体積比で混合され、かつ洗浄能力を有する第２の薬液を供給して、第１の薬液を第２の薬液で置換する第４のステップを有することにより、更には第４のステップの前に洗浄水で第１の薬液を希釈するステップを設けている。これにより、第１の薬液を第２の薬液で置換しつつ洗浄槽内の第１の薬液中に浮遊するパーティクルを第１の薬液と共に洗浄槽から溢流させて、排出すると共に、第４のステップ中で、パーティクルがウエハに再付着しても、付着したパーティクルを再び第２の薬液の解離能力によって解離させ、第１の薬液と共に洗浄槽から溢流させることができる。よって、従来の洗浄方法に比べて、ウエハに付着したままになるパーティクルの数が、大幅に減少し、ウエハのパーティクルの除去率を大幅に高めることができる。また、本発明に係るウエハ洗浄装置は、本発明方法を好適に実施できる洗浄装置を実現している。

【図面の簡単な説明】

【図１】実施形態例１のウエハの洗浄方法の手順を示すフローチャートである。

【図２】実施形態例２のウエハの洗浄方法の手順を示すフローチャートである。

【図３】実施形態例のウエハ洗浄装置の構成を示す斜視図である。

【図４】ウエハ洗浄装置の正面図であって、ウエハＷを浸漬させた状態を示す。

【図５】実施形態例３のウエハの洗浄方法の手順を示すフローチャートである。

【図６】従来のウエハ洗浄装置の構成を示す斜視図である。

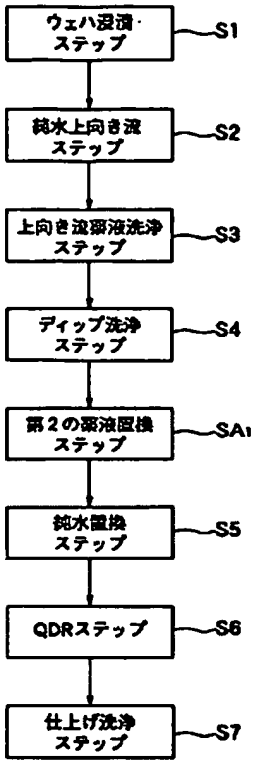
【図７】ウエハ洗浄装置の正面図であって、ウエハＷを浸漬させた状態を示す。

【図８】従来のウエハの洗浄方法の手順を示すフローチャートである。

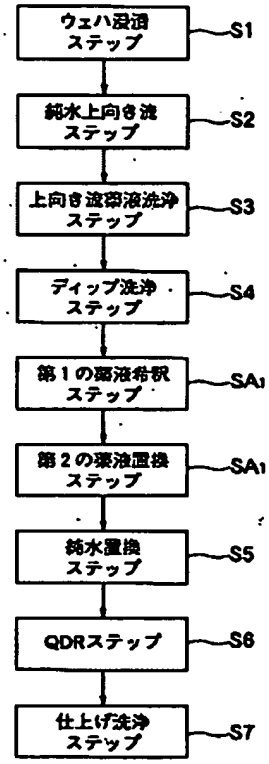
【符号の説明】

１０　ウエハ洗浄装置
１２　内槽
１４　外槽
１６　リフタ
１６ａ　載置台
１６ｂ　把手
１６ｃ　保持溝
１８　薬液・純水供給管
２０　ＱＤＲ用ドレイン口
２２　排出口
３０　実施形態例のウエハ洗浄装置
３２　薬液・純水供給管
３４　ノズル孔

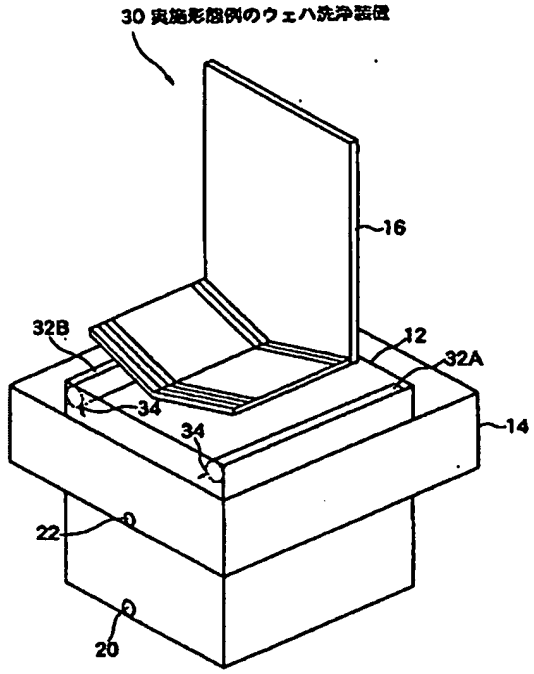
【図１】



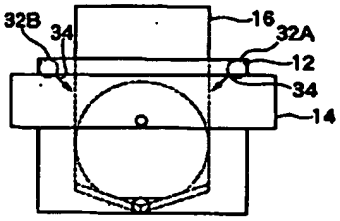
【図２】



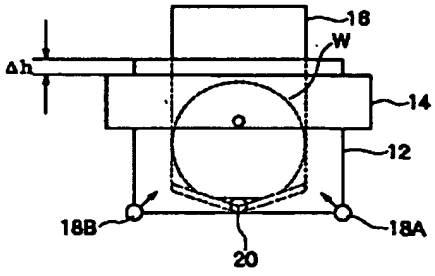
【図３】



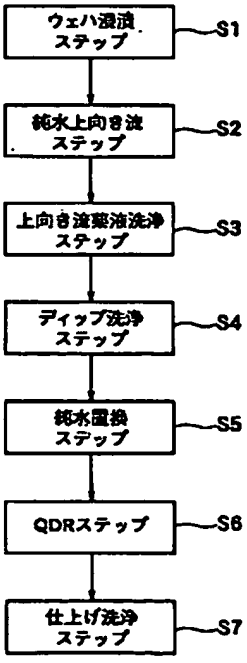
【図４】



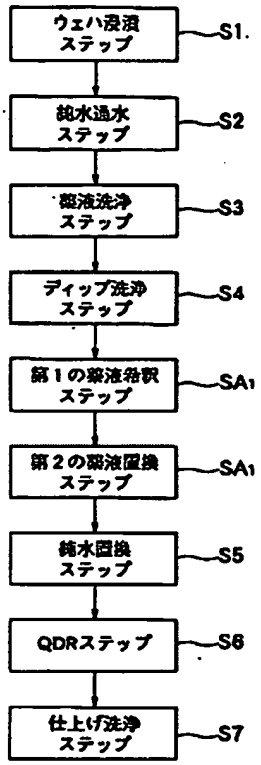
【図７】



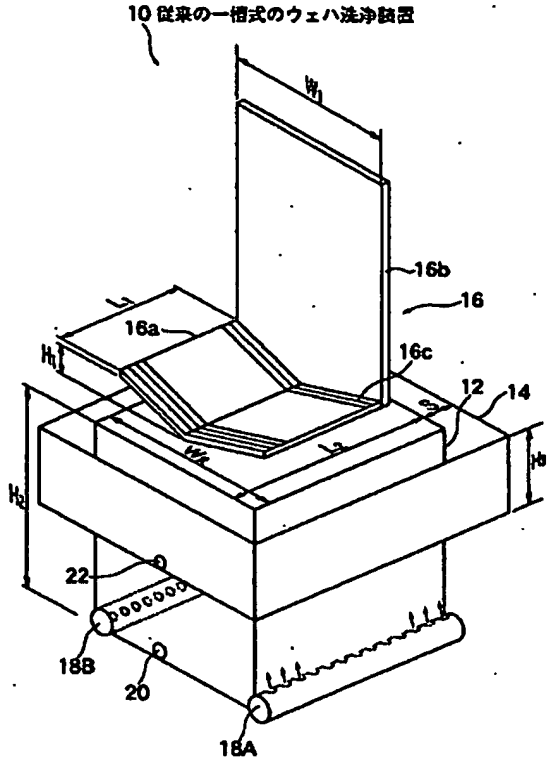
【図８】



【図５】


ウェハ浸漬
ステップ
S1
純水通水
ステップ
S2
酸液洗浄
ステップ
S3
ディップ洗浄
ステップ
S4
第１の薬液希釈
ステップ
SA1
第２の薬液置換
ステップ
SA1
純水置換
ステップ
S5
QDRステップ
S6
仕上げ洗浄
ステップ
S7

【図６】


10 従来の一槽式のウェハ洗浄装置
16b
16
16a
16c
12
14
22
18B
20
18A